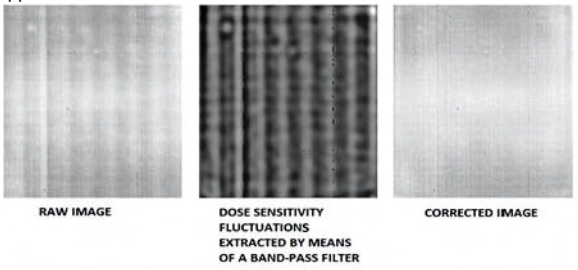
optical density (OD). The optical density distributions were then corrected for the acquisition-related distortion by means of an algorithm available in literature. The dose fluctuation pattern inherent to helical TomoTherapy was then extracted by applying another band-pass filter. Finally, after the application of an OD-dose calibration, the dose distributions were filtered in order to reduce low and high frequency noise. For the selection of the most suitable filter various possibilities were tested, including the complete removal of the predetermined frequency range which characterizes the batch. The quality of the uniformity correction protocol was evaluated by comparing passing rates obtained with films and those achieved with PTW OCTAVIUS system.
Results: The level of dose sensitivity variations depends on the specific batch [2-4] %. The frequency range seems to be similar for intra-batch films, while different for inter-batch films. The pure elimination of the band frequency range is not applicable. This is because the frequencies that characterized the dose sensitivity variations and those that characterized the dosimetric information are comparable. The best low and high frequency noise reduction is obtained by applying the wavelet filtering method and separately adding the dose fluctuation pattern inherent to helical TomoTherapy to the SBRT dose distribution. Using a gamma function 3mm-3%, agreement between planned and measured dose distributions was found to be always better then 90% only if the correction protocol was applied.



Conclusions: Radio chromicfilms response, if corrected by our protocol, can be used for the verification of TomoTherapy SBRT plans where high spatial resolution is needed.

POSTER: PHYSICS TRACK: DOSE MEASUREMENTS

PO-0771
A reliable algorithm for calculating 3D patient dose based on measured point doses in a QA phantom
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Purpose/Objective: QA phantoms for dose verification of complex radiation treatments such as IMRT and VMAT are currently in widespread use. By monitoring beam or control point dose in a large number of small detectors distributed within the QA phantom and comparing measured dose with TPS calculated dose *in the QA phantom*, accurate confirmation of spatial deviations between planned and delivered dose can be obtained.The clinical interpretation of deviations is however limited by the fact that doses are being compared in the QA phantom. To facilitate evaluation of the clinical impact of observed dose deviations, the TPS calculated dose *in the patient* should ideally be compared with the patient dose distribution *corresponding to* the measured doses in the QA phantom.
Materials and Methods: This work describes the development and validation of a novel technique for accurate and reliable 3D photon dose calculation in a patient volume based on detector dose measurements in a QA phantom of arbitrary material. The technique consists of two steps:
1. For the given beam quality and accounting for the phantom composition, estimate the 2D energy fluence distribution that best represents the measured detector doses in the QA phantom.
2. Apply the obtained energy fluence and the given beam quality in a 3D dose calculation for the patient volume.
The estiated energy fluence distribution represents the radiant energy resulting from modulation and collimation in the treatment head,independent of dose calculation geometry. Presence or absence of flattening filter is automatically accounted for.
The energy fluence estimation is formulated as a linear optimization problem, where the objective is to minimize the integral fluence given that the calculated phantom dose in every accountable detector position is greater than or equal to the measured dose. This formulation is guaranteed to have a feasible solution and the calculated-to-measured dose deviation is implicitly minimized through the integral fluence objective.
Results: The technique has been applied to both MLC collimated IMRT fields with non-uniform energy fluence and VMAT fields where patient dose is calculated for the individual control points and subsequently added to yield a total 3D dose. The technique is consistently able to reproduce reference absolute dose results within 3% and 3 or 6 mm, depending on the local spatial resolution of the detector grid.
Conclusions: A technique for calculating 3D photon dose in the patient volume based on measured detector doses in a QA phantom has been implemented. The technique is applicable to complex treatments such as IMRT and VMAT and has been shown to accurately and reliably obtain 3D patient dose distributions that can be immediately compared with 3D dose distributions planned and calculated with a regular treatment planning system.

PO-0772
Applicability of AAPM TG 119 on a 3D dosimetric phantom
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Purpose/Objective: Treatment planning system (TPS) capabilities should beverified in a real 3D situation with rigorous procedures, both for static and rotational modulated fields.
The American Association of Physicists in Medicine TaskGroup 119 (TG119) proposed a water equivalent square slab phantom (30x30x15 cm^3) with four IMRT tests: mock prostate (MP), head-and-neck (HN), C-shaped target (CS), and Multi Target (MT). Each test was developed to assess the overall accuracy of planning and delivery of IMRT treatments. The test suite with DICOM-RT images and structures can be downloaded from the AAPM web-site. TG119 defines also beams arrangement, IMRT goals, and methods for analyzing the dosimetric results on their phantom. The AAPM phantom is cheap and easily reproducible in every department, but it allows only single point or single planar measurements. In order to apply the TG119 report in a more sophisticated situation we used a 3D dosimetric phantom and all tests were re-optimized to satisfy all defined goals.
Materials and Methods: TG119 was pre-emptively used 'as is' in order to test the capability of our clinical arrangement. After this, TG119 structures were superimposed on the CT images of a cylindrical PMMA phantom surrounding two orthogonal matrix with 1069 total diodes (Delta4 - 3D dosephantom; Scandidos, SWE). TG119 tests were thus calculated and optimized using a Monte Carlo TPS (Monaco3.20; Elekta, SWE) for 6 and 10 MV photon beams, with IMRT and VMAT techniques, following the plan proposed goals. Delta4 phantom was used in order to carryout comparison between measured and planned 3D absolute dose distributions. A 3%, 3mm with a 10% threshold (defined by the isodose line representing 10% of maximum dose) gamma test was performed for plans analysis.
Results: Goals proposed in TG119 were satisfied for each planand technique. For all IMRT plans gamma values were lower than 1 for more than 98.3% of compared point, except for the CS plan delivered with 6 MV (Fig.1), where gamma analysis was satisfied for 90.5% of total points. The mean percentage of passing points for all energies was 98.4 ± 3.3%. Preliminary results were obtained for VMAT cases, with a mean percentage of 88.5 ± 8.4%. VMAT is at present under refinement and better results are expected after the optimisation of the Monte Carlo model.

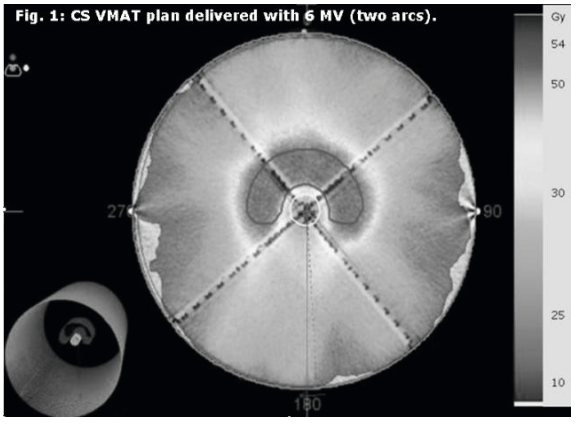

Fig. 1: CS VMAT plan delivered with 6 MV (two arcs).